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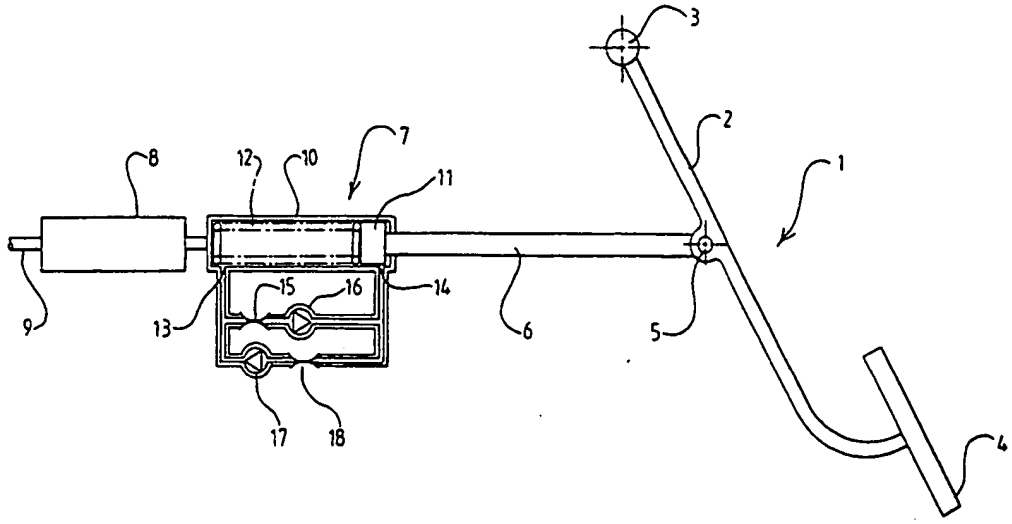

(57) Abstract

A foot pedal arrangement (1) in a motor vehicle has a movably mounted arm (2) carrying a plate (4), the arm being connected to a linkage (6) which in turn is connected to an element, such as a master cylinder (8) actuated by the pedal. The pedal is provided with an arrangement (7) responsive to the application of a force in excess of a predeterminated force to the plate (4) to permit the plate (4) to move forwardly of the vehicle, thus minimising the risk of injury to the driver of the vehicle in the event of a frontal impact. The linkage (6) may incorporate a piston (11) movable within a hydraulic cylinder (10), opposed ends of the cylinder being inter–connected by a flow path incorporating a constriction.

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"A FOOT PEDAL ARRANGEMENT"

THE PRESENT INVENTION relates to a foot pedal arrangement and in particular relates to a foot pedal arrangement to be mounted in a motor vehicle such as a motor car.

It has been found that in car crashes that involve a frontal impact, a substantial proportion of the injuries experienced by the occupants of the vehicle occur to the lower extremities of the occupants of the vehicles, such as their legs, ankles and feet, and it is thought that a substantial proportion of these injuries may be attributed to the occupant of the vehicle impacting with the foot well and/or the pedals of the motor vehicle. In a typical accident situation the driver will have one foot on the brake pedal, and possibly the other foot on the clutch pedal. If the pedals move towards the driver, as a result of the accident, the driver may break or sprain one or both feet.

It has been thought that approximately half of the injuries to the lower extremities experienced by the drivers of the vehicle involved in frontal car crashes are caused by the lower extremities of the driver impacting with the pedals.

A brake pedal is typically made strong enough to withstand the maximum possible force that a driver could apply to the brake pedal, that force being far

higher than the force that is needed to fully apply the brakes. In many motor vehicles the clutch pedal is of the same design as the brake pedal, and consequently the clutch pedal is also relatively strong.

A brake pedal of this strength, and clutch pedal of this strength, can impart substantial injuries to the lower extremities of the driver during a crash. Typically the driver will be braking to avoid the crash and may also be de-clutching. At the instant of the crash, the driver is typically thrown forward, and a substantial force is transmitted through the legs of the driver on to the pedals which do not yield.

It is to be appreciated that in some severe frontal impacts, due to deformation of the body of the vehicle, the pedal assembly can be moved into the foot well, and this may cause very high forces to be applied to the lower extremities of the driver by the pedals.

DE-A-19616845 discloses a foot pedal arrangement in which the pivot point of the foot pedal is yieldably mounted in position. When an extremely high force is applied to the foot pedal, the pivot point of the foot pedal is released so that the plate of the foot pedal will move forwardly of the body of the vehicle. However, once the pivot point of the foot pedal has been released, the foot pedal is no longer operative. If the pedal is a brake pedal, the brakes cannot be applied by the foot pedal. Also the arrangement requires attention from a mechanic before the foot pedal may be used again.

The present invention seeks to provide a safety device which overcomes or mitigates the problem outlined above.

Accordingly, the invention provides a foot pedal arrangement in a motor vehicle, the arrangement comprising a pedal having a movably mounted arm

carrying a plate, the arm being connected to a linkage, which is connected to an element actuated by the pedal, the pedal having a predetermined initial position, the pedal being associated with means responsive to the application of a force in excess of a predetermined force to said plate, to permit the plate to move forwardly of the vehicle, and adapted to return the pedal to the initial position when force is no longer applied to said plate.

Conveniently, the pedal comprises an elongate arm which is pivotally mounted at one end and carries said plate at the other end, a point between the two ends of the arms being connected to the linkage.

In an embodiment of the invention, the force responsive means comprise a compression spring, preferably a damped return spring.

Advantageously, said damped return spring comprises a tubular housing containing a piston, said compression spring biasing the piston towards one end of the housing, the housing being provided, at opposed ends, with flow ports communicating with the interior of the housing, the ports being connected by parallel flow paths, one flow path containing a constriction and a non-return valve permitting flow in one direction, the other flow path containing at least a non-return valve.

The said other flow path may also include a constriction.

The housing may contain a hydraulic fluid, or may contain as gas, the damped return spring then comprising a gas spring.

In one form of the invention, the force responsive means are provided in the linkage between the pedal and a master cylinder.

In another form of the invention, the force responsive means are mounted between part of the arm of the pedal, and a fixed mounting point provided on the vehicle.

In a further form of the invention, the force responsive means comprise means responsive to hydraulic pressure in excess of a predetermined hydraulic pressure in the outlet of a master cylinder, which comprises the element actuated by the pedal.

In an alternative arrangement the force responsive means comprise a chamber connected to the outlet of the master cylinder, the chamber containing a flexible membrane dividing the chamber into two parts, one part being in communication with the outlet of the master cylinder and the other part containing compressed gas.

Preferably said predetermined force is equal to or greater than the maximum force required to actuate the element actuated by the pedal.

In one embodiment this latter form of the invention, the force responsive means may comprise a cylinder containing a piston, the cylinder being connected, by means of a connecting conduit, to the outlet of the master cylinder, the piston being biased towards said conduit by a compression spring, the piston being movable against the bias of the spring in response to a pressure in excess of a predetermined pressure present at the outlet of the master cylinder.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, embodiments of the invention will now

be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a diagrammatic representation of a foot pedal in a motor vehicle, illustrating one embodiment of the present invention,

FIGURE 2 is a view corresponding to Figure 1 illustrating a modified embodiment of the invention,

FIGURE 3 is a view, corresponding to Figures 1 and 2, illustrating yet another embodiment of the invention, and

FIGURE 4 is a view corresponding to Figure 3 illustrating a further embodiment of the invention.

Referring initially to Figure 1 of the accompanying drawings, a pedal 1 mounted in a motor vehicle is illustrated. The pedal 1 may comprise a brake pedal or a clutch pedal.

The pedal 1 comprises an elongate arm 2, the upper end of which is pivotally connected at 3 to an appropriate mounting point provided in the body shell of the motor vehicle. The lower end of the arm 2 is provided with a plate 4 adapted to be engaged by the foot of the driver. The plate 4 may be provided with a rubber sheath. The pedal has a predetermined initial position, as shown in Figure 1.

At the mid point of the arm 2, a pivotal linkage 5 is provided which connects the arm 2 to an actuating rod 6. The actuating rod 6 extends to damped spring connector 7 which will be described hereinafter, and thence to an element to

be actuated by the pedal which, in this embodiment, a master cylinder 8. The master cylinder 8 has a hydraulic output 9 which can be connected to a brake or to a clutch, as is conventional.

The damped spring connector 7 comprises a tubular housing 10, one end of which is connected to the master cylinder 8. Contained within the tubular housing 10 is a piston 11, which is connected to the rod 6. The piston 11 is biased to one end of the tubular housing by means of a very strong compression spring 12. The space between the piston 11 and the closed end of the housing is filled with a hydraulic fluid. The housing is provided with inlet and outlet ports 13,14 provided at the opposed ends of the housing. The inlet/outlet ports are inter-connected by a parallel connection of two flow paths. One flow path comprises a constriction 15 and a non-return valve 16 which permits flow of the fluid in one direction, that direction being towards the left as shown in Figure 1, and a second flow path which comprises a non-return valve 17 and a constriction 18, the non-return valve 17 permitting flow in one direction, that is to say towards the right as shown in Figure 1. The constriction 18 is optional and may be omitted.

During ordinary use of the pedal, as shown in Figure 1, the force applied to the plate 4 will not be sufficient to compress the spring 12. Thus the damped spring connector 7 will constitute a substantially rigid connection between the pedal 1 and the master cylinder 8. However, should a pressure in excess of a predetermined pressure be applied to the pedal 1, either as a consequence of the driver moving forwardly towards the pedal, whilst depressing the pedal, or as a consequence of the pedal itself moving towards the driver as a consequence of deformation of the vehicle. The piston 11 will move towards the left as shown in Figure 1 against the bias provided by the spring 12, forcing fluid past the non-return valve 17 and the constriction 18. The fluid will leave the cylinder 10 through the port 13 and will re-enter the cylinder 10 through the port 14 on the

other side of the piston 11. The pedal may move to a position in which it is adjacent or in contrast with the floor of the vehicle to minimise the risk of any injuries occurring. When the force is no longer applied to the pedal 1, the spring 12 will return the piston to the initial position illustrated in Figure 1, with the fluid flowing through the non-return valve 16 and the associated constriction 15. Thus the pedal will only return to the initial position relatively slowly, and will thus not injure an occupant of the vehicle following an accident.

It is thus to be appreciated that in the described embodiment, when a pressure in excess of a predetermined pressure is applied to the pedal, the pedal moves forwardly relative to the body of the vehicle, thus minimising the risk of injury to the driver of the vehicle.

Figure 2 illustrates a modified embodiment of the invention. However, a large proportion of the components of the embodiment shown in Figure 2 are the same as those shown in Figure 1, and these components will be identified by the same reference numerals, and will not, therefore, be re-described in detail.

It is to be noted that in the embodiment of Figure 2, the arm 2 of the pedal 1 is mounted, at one end, to a pivot point 3. The pivot point 3 is provided at one end of an arm 19. The other end of the arm 19 is connected to the piston 11 of the damped spring connector 7. The housing 10 of the damped spring connector is secured to an anchor point 20 which is fast with the body of the vehicle. Thus the force responsive means are mounted between one end of the arm 2 of the pedal 1 and a fixed mounting point 20 provided on the vehicle. The rod 6 connected to the pivotal linkage 5 at the mid point of the arm 2 extends directly to the master cylinder 8.

In this embodiment also, if a force in excess of a predetermined force is applied to the pedal 1, as a consequence of an equal and opposite force being applied to the piston 11, because the arm 2 is effectively pivotally mounted about the point 5, the piston will move generally towards the right as shown in Figure 2, against the bias of the spring 12, thus enabling the pedal itself to move forwardly of the vehicle. When force is no longer applied to the pedal it will return to its initial position as shown in Figure 2.

Whilst, in the embodiments described above, the damped spring connector 7 has been described as being filled with a fluid, it is to be understood that instead of being filled with a fluid such as a hydraulic fluid, such a damped spring connector may be filled with gas, and the connector may then be termed a gas spring.

Figure 3 illustrates a further embodiment of the invention. In the embodiment of Figure 3, the output of the master cylinder is connected to an arrangement 21 which is adapted to release the hydraulic pressure within the master cylinder in the event that the pressure exceeds a predetermined threshold. The arrangement shown in Figure 3 comprises a cylinder 22 containing a piston 23. The cylinder 22 is connected to the hydraulic outlet 9 of the master cylinder by means of a connecting conduit 24. The piston 23 is biased towards the connecting conduit 24 by a very strong spring 25.

In ordinary use of the pedal 1, the hydraulic pressure generated at the outlet of the master cylinder 8 is not sufficient to compress the spring 25, and the brake or clutch connected to the outlet 9 of the master cylinder operates in the usual way. However, should a very high force be applied to the pedal 1, a very high pressure will be generated within the master cylinder, and this very high pressure will be present at the outlet 9 of the master cylinder. This high pressure will cause the piston 23 to compress the spring 25. As a consequence, the piston in the master

cylinder that is connected to the rod 6 will move towards the left, as shown in Figure 3, thus permitting the pedal to move to the left, that is to say forwardly of the vehicle.

Figure 4 illustrates another embodiment of the invention. In this embodiment the output of the master cylinder is connected to an arrangement 31 adapted to release the hydraulic pressure within the master cylinder in the event that the pressure exceeds a predetermined threshold.

The arrangement shown in Figure 4 comprises a first pipe 32 which contains a non-return valve 33 which communicates with a chamber 34. The chamber 34 is actually divided into two parts by a flexible membrane 35. The conduit 32 communicates with one part 36 of the chamber which contains hydraulic fluid. The other part 37 of the chamber, on the other side of the membrane 35, contains a compressed gas.

A second conduit 38 is provided which is connected in parallel with the non-return valve 35, the conduit 38 containing a constriction 39.

Should a very high force be applied to the pedal 1, a very high pressure will be generated within the master cylinder 8, and this very high pressure will be present at the outlet 9 of the master cylinder. The high pressure will move past the non-return valve 33 providing a flow of hydraulic fluid into the chamber 34. The membrane 35 will distend, further compressing the gas 37. However, the plate 4 of the foot pedal 1 will be permitted to move forwardly. When force is no longer applied to the plate 4 of the foot pedal, the membrane 35 will gradually return to its initial condition, with hydraulic fluid flowing through the pipe 38, past the constriction 39, back into the hydraulic system adjacent the outlet 9 of the master cylinder. The foot pedal 1 will be returned to its initial position at this time.

It is to be appreciated that the embodiments of Figures 3 and 4 may be utilised, for example, with an ABS braking system.

It is to be appreciated that, in each of the embodiments described, the plate 4 carried by the pedal will move forwardly of the vehicle in response to the application to that pedal of a force in excess of a predetermined force. The force may be applied to the pedal either by the driver of the vehicle exerting that pressure against the pedal, either wilfully, or as a consequence of moving forwardly, due to deceleration of the vehicle, but equally, the force may be applied to the pedal as a consequence of the pedal moving rearwardly of the vehicle into contact with the driver of the vehicle as a consequence of deformation of the body shell of the vehicle. After the force is removed from the pedal, the pedal returns to its initial position.

It is to be noted that in this Specification the term "comprising" is used to mean "including or consisting of" and the term "comprises" is used to mean "includes or consists of".

CLAIMS:

1. A foot pedal arrangement in a motor vehicle, the arrangement comprising a pedal having a movably mounted arm carrying a plate, the arm being connected to a linkage, which is connected to an element actuated by the pedal, the pedal having a predetermined initial position, the pedal being associated with means responsive to the application of a force in excess of a predetermined force to said plate, to permit the plate to move forwardly of the vehicle, and adapted to return the pedal to the initial position when force is no longer applied to said plate.

2. A foot pedal arrangement according to Claim 1 wherein the pedal comprises an elongate arm which is pivotally mounted at one end and carries said plate at the other end, a point between the two ends of the arms being connected to the linkage.

3. An arrangement according to Claim 1 or Claim 2 wherein said force responsive means incorporate a compression spring.

4. An arrangement according to Claim 3 wherein said force responsive means comprise a damped return spring.

5. An arrangement according to Claim 4 wherein said damped return spring comprises a tubular housing containing a piston, said compression spring biasing the piston towards one end of the housing, the housing being provided, at opposed ends, with flow ports communicating with the interior of the housing, the ports being connected by parallel flow paths, one flow path containing a constriction and

a non-return valve permitting flow in one direction, the other flow path containing at least a non-return valve.

6. A foot pedal arrangement according to Claim 5 wherein said other flow path also includes a constriction.

7. An arrangement according to Claim 5 or 6 wherein the housing contains a hydraulic fluid.

8. An arrangement according to Claim 5 or 6 wherein the housing contains gas.

9. A foot pedal arrangement according to any one of the preceding Claims wherein the force responsive means are provided in the linkage between the pedal and a master cylinder.

10. An arrangement according to any one of Claims 1 to 8 wherein the force responsive means are mounted between part of the arm of the pedal, and a fixed mounting point provided on the vehicle.

11. An arrangement according to any one of the preceding Claims wherein the force responsive means comprise means responsive to hydraulic pressure in excess of a predetermined hydraulic pressure in the outlet of a master cylinder which comprises the element actuated by the pedal.

12. An arrangement according to Claim 11 wherein the force responsive means comprise a cylinder containing a piston, the cylinder being connected, by means of a connecting conduit, to the outlet of the master cylinder, the piston being biased towards said conduit by a compression spring, the piston being movable against the

bias of the spring in response to a pressure in excess of a predetermined pressure present at the outlet of the master cylinder.

13. An arrangement according to Claim 11 wherein the force responsive means comprise a chamber connected to the outlet of the master cylinder, the chamber containing a flexible membrane dividing the chamber into two parts, one part being in communication with the outlet of the master cylinder and the other part containing compressed gas.

14. A foot pedal arrangement according to any one of the preceding Claims wherein said predetermined force is equal to or greater than the maximum force required to actuate the element actuated by the pedal.

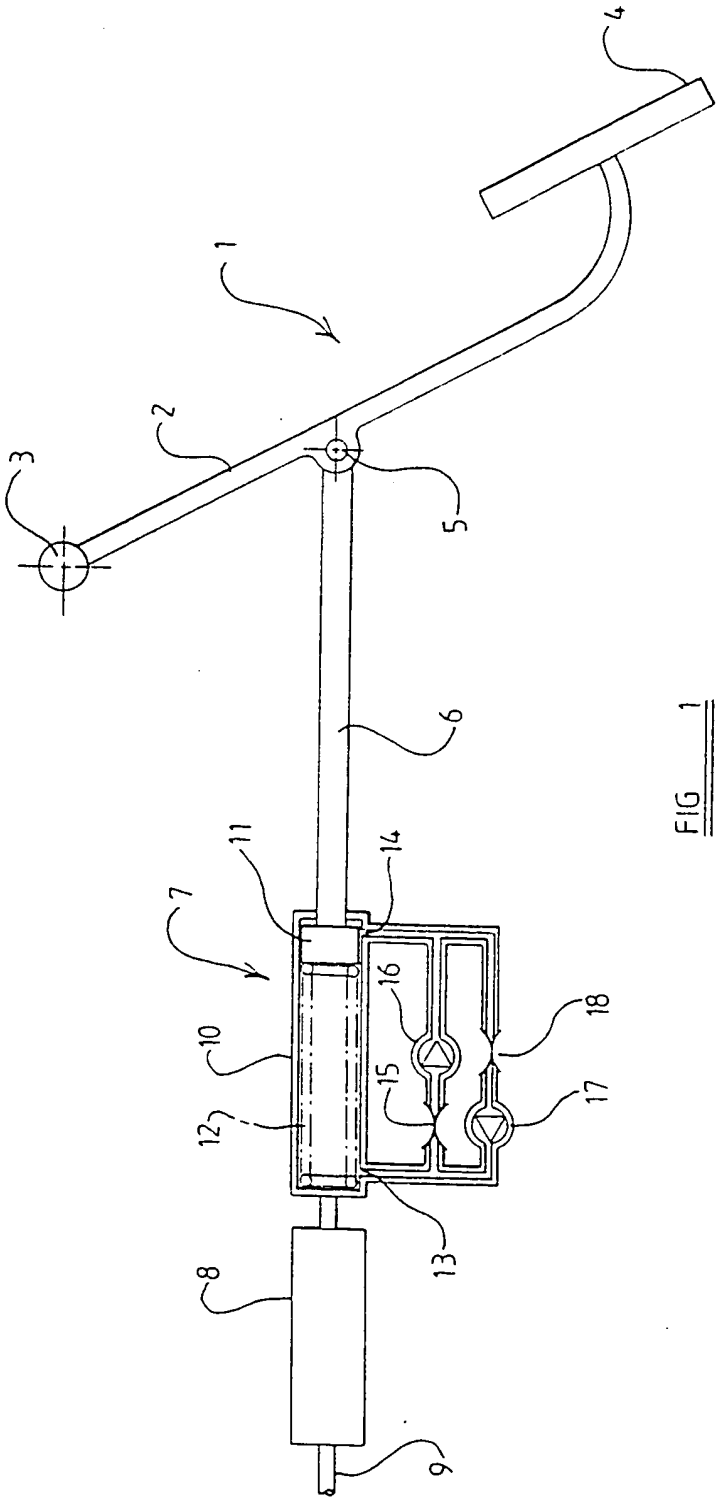

FIG 1

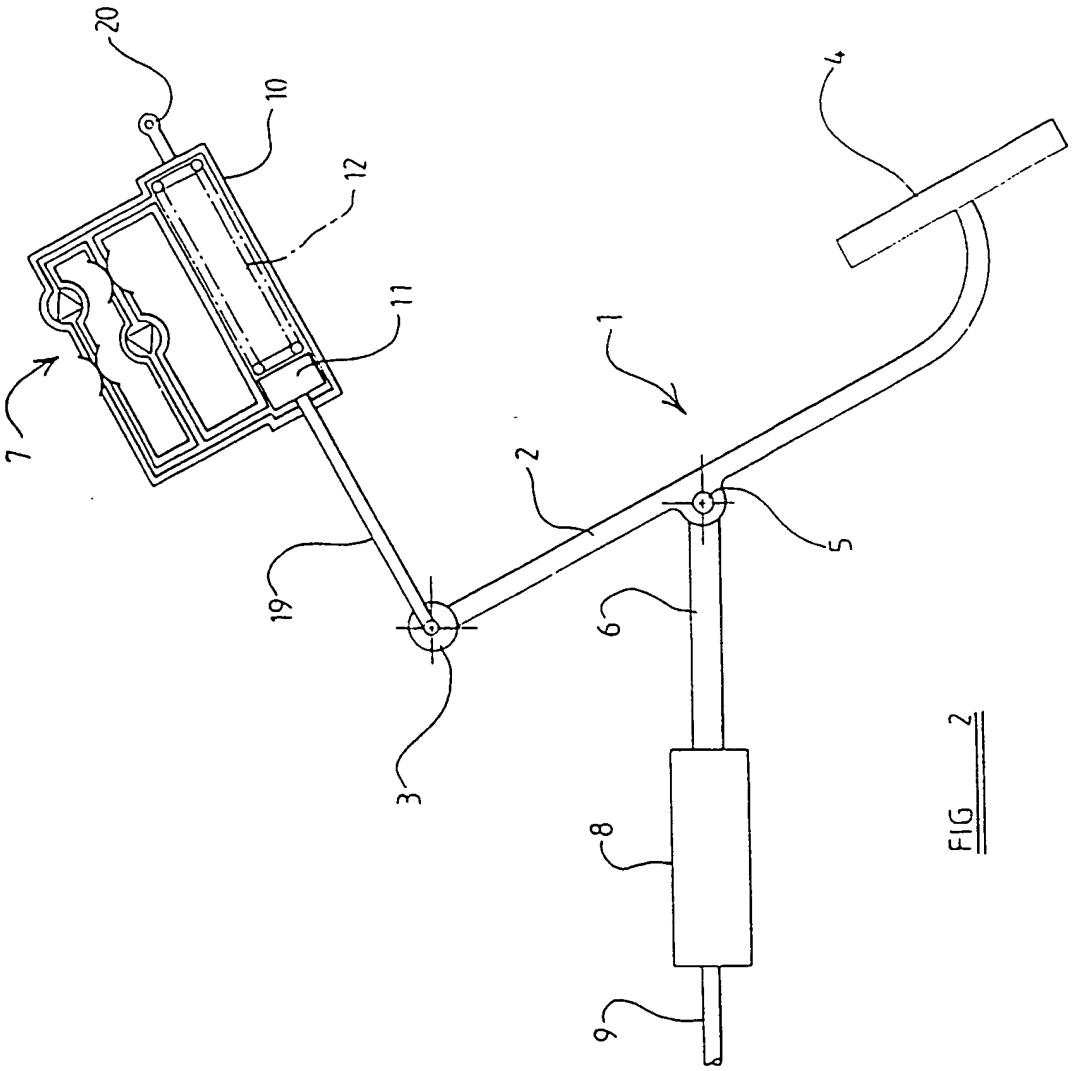

FIG 2

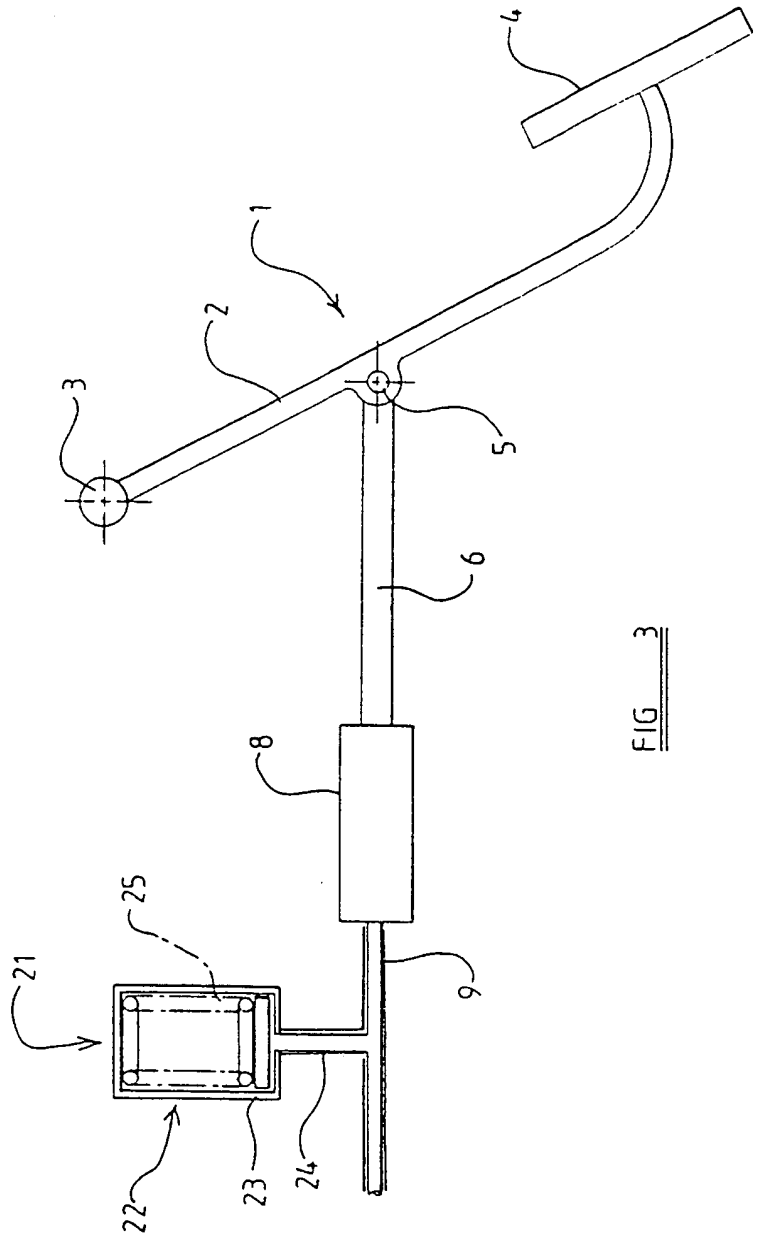

FIG 3

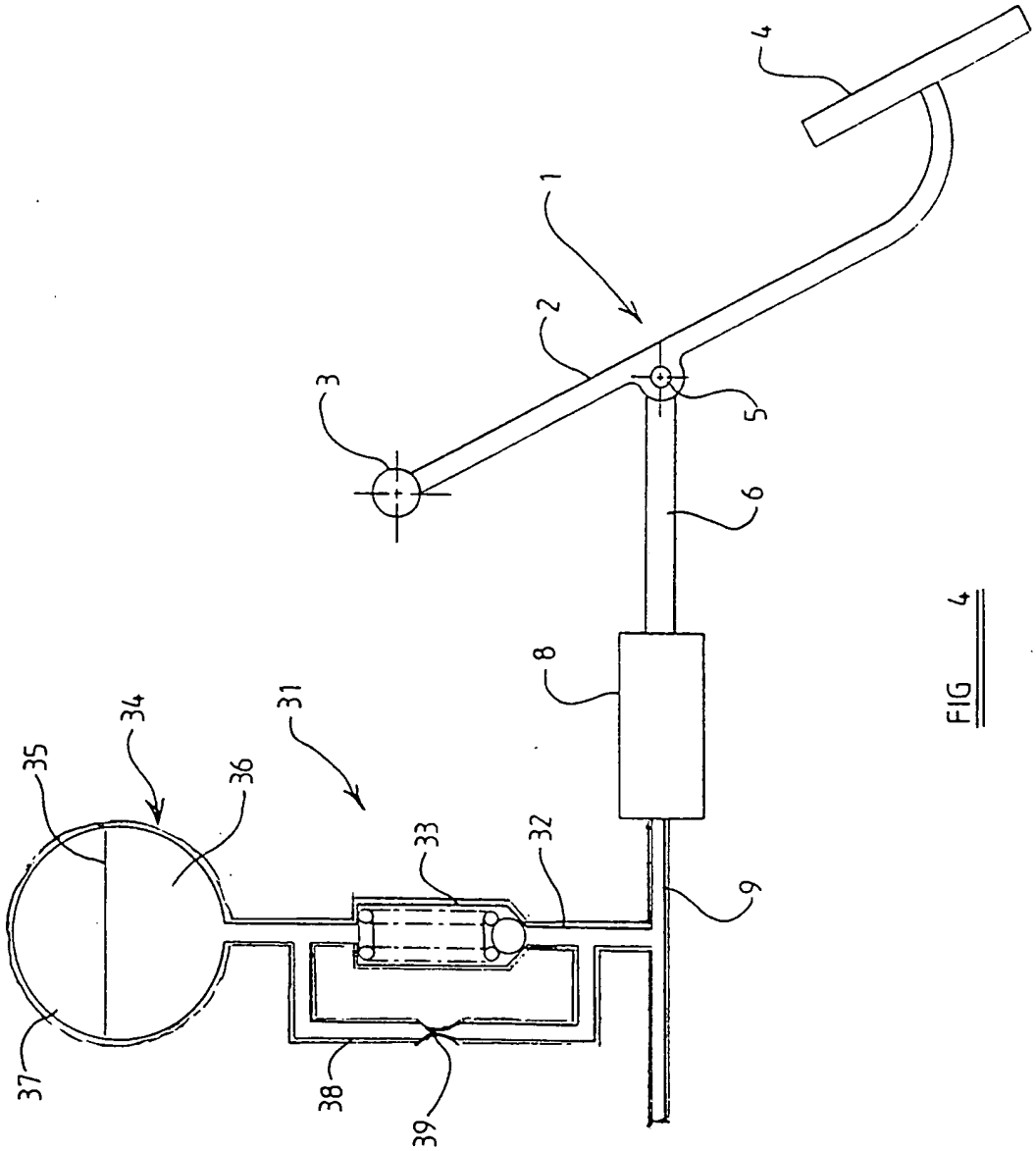

FIG 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/00849

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G05G 1/14, B60T 7/06, B60R 21/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B60T, G05G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 19505001 A1 (F. PORSCHE AG), 22 August 1996 (22.08.96), col. 4, line 28 - col. 5, line 1; pos. 13,14 and 17-19, fig. 1 and fig. 2 --	1-4,9-14
X	DE 19624548 A1 (VOLKSWAGEN AG), 2 January 1997 (02.01.97), col. 3, lines 41-63, pos. 3,22,23 and fig. 2 --	1-4,11,12,14
X	GB 2241050 A (FORD MOTOR COMPANY LIMITED), 21 August 1991 (21.08.91), fig. 2 and fig. 3, pos. 34 --	1,10

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
21 Sept 1999	27 -09- 1999
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/00849

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	DE 19752231 A1 (ITT MFG. ENTERPRICES, INC.), 27 May 1999 (27.05.99), abstract, fig. 1	1-4,14

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INTERNATIONAL SEARCH REPORT

Information on patent family members

30/08/99

International application No.
PCT/SE 99/00849

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19505001 A1	22/08/96	NONE	
DE 19624548 A1	02/01/97	DE 19645200 A	22/05/97
GB 2241050 A	21/08/91	NONE	
DE 19752231 A1	27/05/99	NONE	

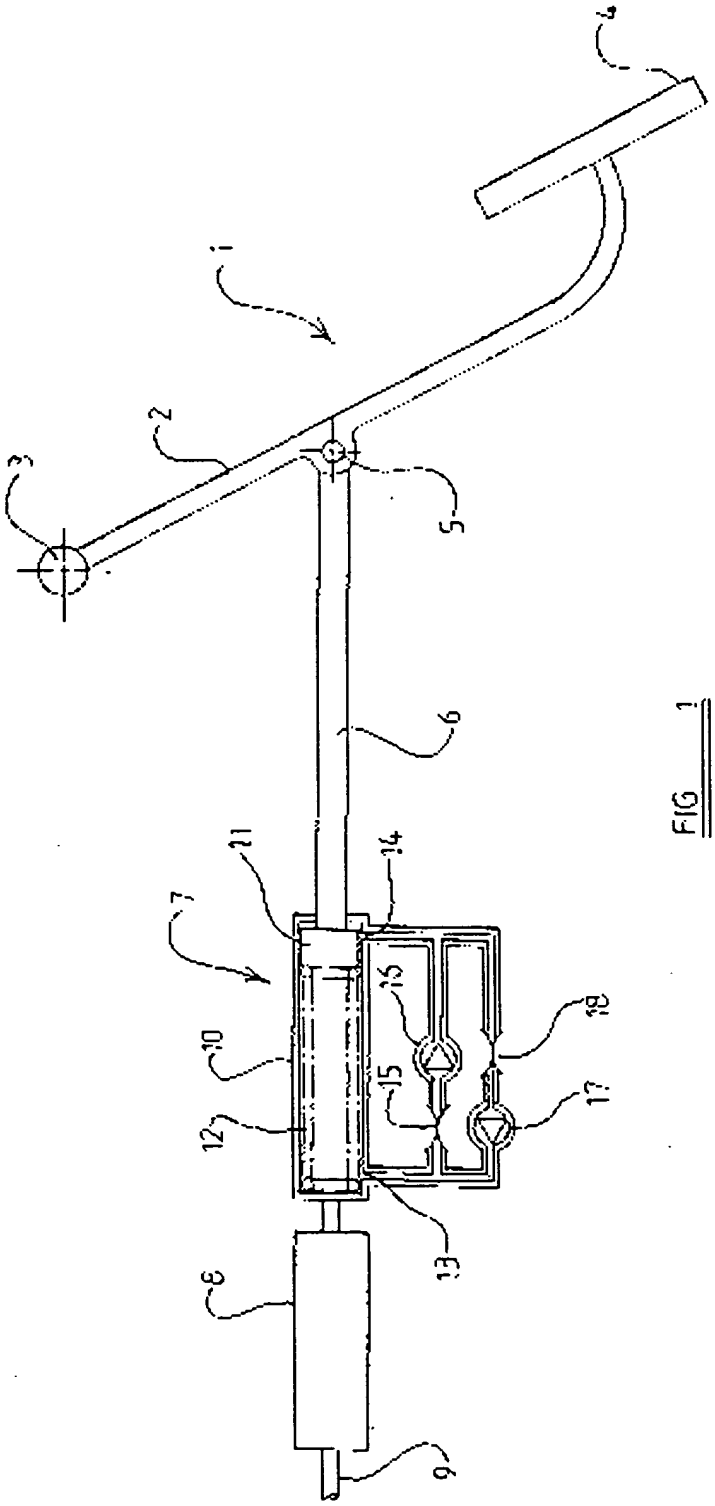

FIG 1

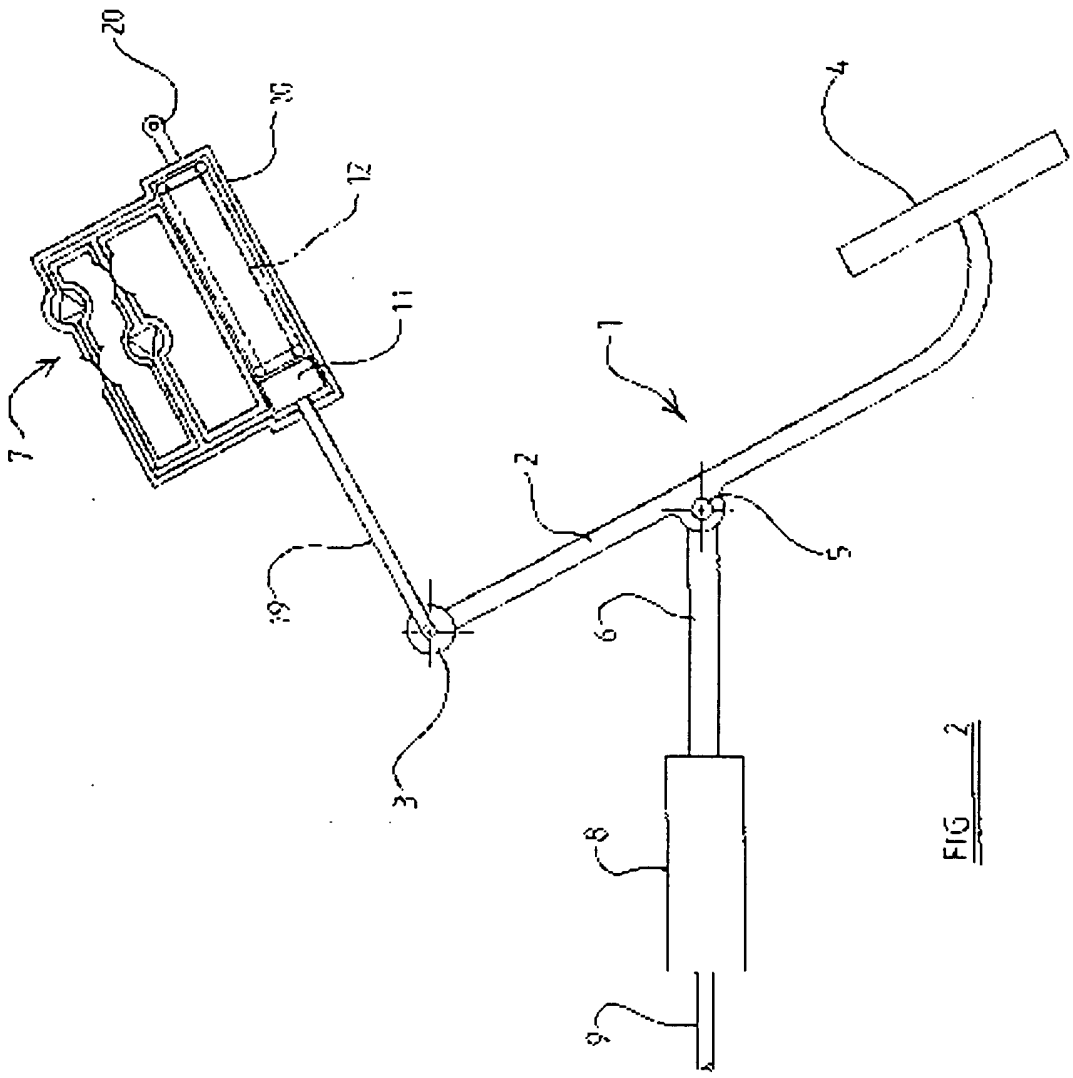

FIG 2

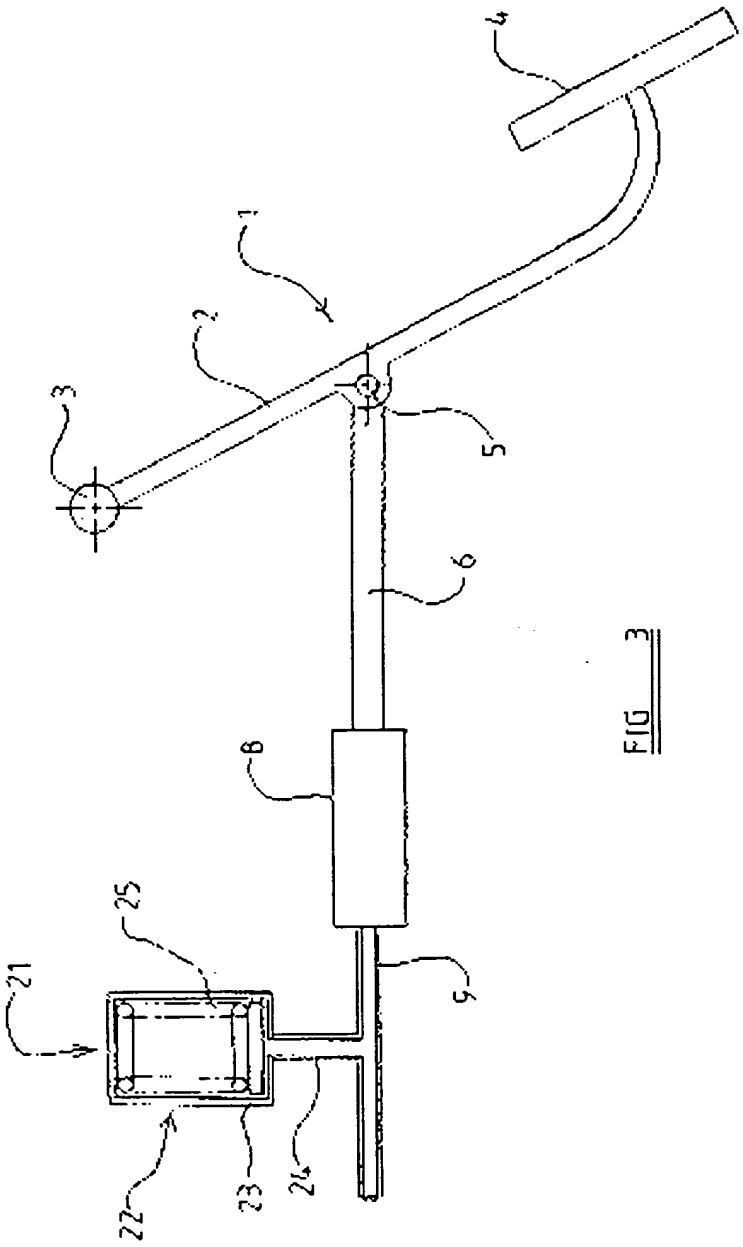

FIG 3

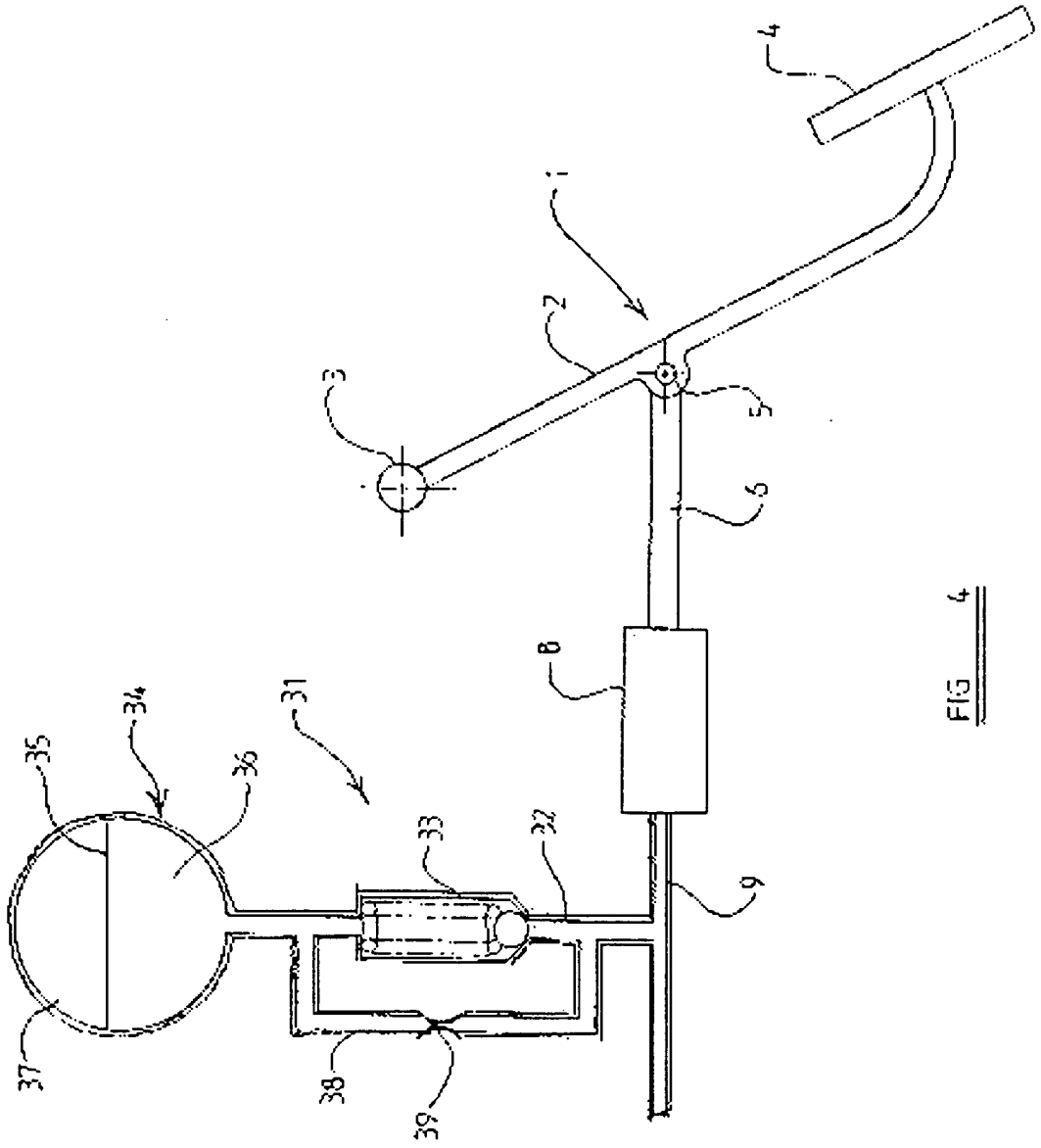

FIG 4